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Brain Tumor Classification and Segmentation using Mask R-CNN

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Abstract: MRI segmentation is a crucial task in many clinical applications. A variety of approaches for brain analysis rely on accurate segmentation of anatomical regions. Quantitative analysis of brain MRI has been used extensively for the characterization of brain disorders such as Alzheimer's, epilepsy, schizophrenia, multiple sclerosis, cancer, and many infectious, degenerative diseases. Manual Segmentation requires outlining structures slice-by-slice, it is not only expensive and tedious but also inaccurate due to human error. Also, manual segmentation is extremely time-consuming and initial hours of brain tumor and strokes are crucial to diagnose it. Therefore, automated segmentation procedures are needed to ensure accuracy close to that of experts with high consistency. We propose to create a Deep Learning based Brain Segmentation solution that would fully automate the process of Brain Tumor Segmentation to solve those cases which are generally missed by the human eye and save time.

I. INTRODUCTION

Brain cancer is a fatal disease affecting millions of people worldwide and has a high mortality rate. Brain tumors represent a cluster of abnormal cells that develop and multiply uncontrollably within normal brain cells and cause damage to the nervous system that controls different functions in the human body. Early identification and segmentation of brain tumors increases the survival chances of the patient and also saves them from complex surgical processes. Moreover, the precise segmentation of brain tumors facilitates the surgeon for better clinical development and cure. Manual detection and segmentation of brain tumors is slow and it suffers from a high error rate. Thus, the demand for effective computer-aided brain tumor segmentation techniques has increased considerably in recent times. However, accurate brain tumor segmentation is still a challenge because of its structural complexity such as variations in location, size, shape, and overlapping tumor boundaries with normal brain tissues.

II. LITERATURE REVIEW

Since many years, a lot of researchers have done a huge amount of work in the field of Machine Learning & Deep Learning. Researchers have provided various methods for the detection of the brain tumors from the MRI scan of the patient.Previously Machine Learning techniques have been implemented for the detection of bounding boxes. The second stage, which is the brain tumor such as Median filter GA segmentation[7], Wiener filtering Histogram based segmentation[8], Morphological operation, pixel subtraction, Maximum entropy threshold segmentation[9] for preprocessing, segmentation and GLCM[7][8], Morphological ,Intensity[9] for feature extraction and SVM[7], G-K Fuzzy system[8], Naive Bayes[9] for classification. Also there have been use of the deep learning techniques for the detection of brain tumor such as Image resizing, data augmentation[10], average feature, pixel subtraction[11], min-max intensity normalization[12] for preprocessing and CNN[10], CNN-LinkNet, VGG19[12] for image classification.

III. PROPOSED METHOD

This project aims at providing a better detection technique which will help the medical technicians to detect the tumor at the earliest possible with good accuracy.

1) *Mask R-CNN is conceptually simple:* Faster R-CNN has two outputs for each candidate object, a class label and a bounding-box offset; to this we add a third branch that outputs the object mask. Mask R-CNN is thus a natural and intuitive idea. But the additional mask output is distinct from the class and box outputs, requiring extraction of much finer spatial layout of an object. Next, we introduce the key elements of Mask R-CNN, including pixel-to-pixel alignment, which is the main missing piece of Fast/Faster R-CNN.
2) *Faster R-CNN:* We begin by briefly reviewing the Faster R-CNN detector [1]. Faster R-CNN consists of two stages. The first stage, called a Region Proposal Network (RPN), proposes a candidate object in essence Fast R-CNN [2], extracts features using RoIPool from each candidate box and performs classification and bounding-box regression. The features used by both stages can be shared for faster inference. We refer readers to [3] for latest, comprehensive comparisons between Faster R-CNN and other frameworks.

3) *Mask R-CNN:* Mask R-CNN adopts the same two-stage procedure, with an identical first stage (which is RPN). In the second stage, in parallel to predicting the class and box offset, Mask R-CNN also outputs a binary mask for each RoI. This is in contrast to most recent systems, where classification depends on mask predictions (e.g. [33, 10, 26]). Our approach follows the spirit of Fast R-CNN [2] that applies bounding-box classification and regression in parallel (which turned out to largely simplify the multi-stage pipeline of original R-CNN [4])

Different Steps for the Detection of the Brain tumor

a) *Anchor sorting & Filtering:* Visualizes every step of the first stage Region Proposal Network and displays positive and negative anchors along with anchor box refinement.
b) *Bounding box Refinement:* Bounding-box regression is a popular technique to refine or predict localization boxes in recent object detection approaches. Typically, bounding-box regressors are trained to regress from either region proposals or fixed anchor boxes to nearby bounding boxes of predefined target object classes.
c) *Mask generation:* Masks are generated and then these get scaled and placed on the image in the right location.
d) *Layer Activation:* Often it's useful to inspect the activations at different layers to look for signs of trouble (all zeros or random noise).
e) *Weight Histograms:* A weighted histogram shows the weighted distribution of the data. If the histogram displays proportions (rather than raw counts), then the heights of the bars are the sum of the standardized weights of the observations within each bin.
f) *Logging to TensorBoard:* TensorBoard is another great debugging and visualization tool. The model is configured to log losses and save weights at the end of every epoch.
g) *Composing the different pieces into a final result:* Combining all the above to get the detected part.

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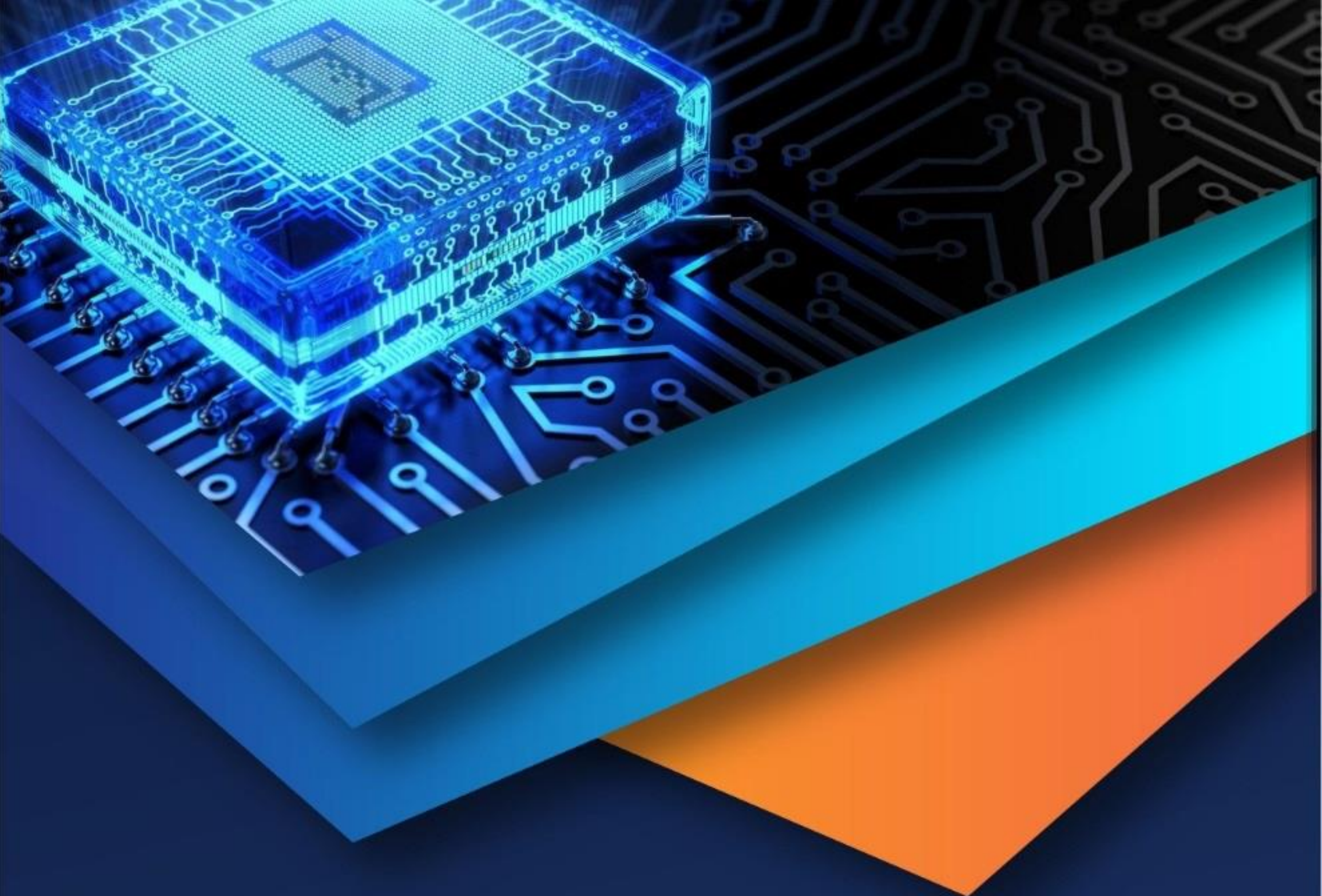

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